GEOLOGIC MAPPING OF ATHABASCA VALLES. L. P. Keszthelyi[1], W. L. Jaeger[1], K. Tanaka[1], and T. Hare[1], [1]U.S. Geological Survey, Astrogeology Team, 2255 N. Gemini Dr., Flagstaff, AZ 86001.

Introduction: We are approaching the end of the third year of mapping the Athabasca Valles region of Mars. The linework has been adjusted in response to new CTX images and we are on schedule to submit the 4 MTM quads (05202, 05207, 10202, 10207) and accompanying paper by the end of this fiscal year.

Previous Work: The study area is of special interest for several reasons: (a) it is central to the controversial and now disproven "Elysium Sea" [1,2]; (b) it contains one of the best preserved outflow channels on Mars [2-4]; (c) the lavas that drape the entire channel system are the best example of a turbulent flood lava anywhere in the Solar System [2,5]; (d) the extremely young lavas have interesting stratigraphic relationships with the long-puzzling Medusae Fossae Formation (MFF). The map area also covers the confluence of lavas from the Elysium rise, multiple small vents, and vast flood lavas [6-9]. Moreover, the remnant knobs of ancient highlands in this region may help constrain the current nature of the Highlands-Lowlands Boundary (HLB).

Mapping Methodology: Two factors drive us to map the Athabasca Valles area in unusual detail: (1) the extremely well-preserved and exposed surface morphologies and (2) the extensive high resolution imaging. The mapping has been done exclusively in ArcGIS, using individual CTX, THEMIS VIS, and MOC frames overlying the controlled THEMIS IR daytime basemap. MOLA shot points and gridded DTMs are also included. It was found that CTX images processed through ISIS are almost always within 300 m of the MOLA derived locations, and usually within tens of meters, with control. The generally good SNR and minimal artifacts make the CTX images vastly more useful than the THEMIS VIS or MOC images. Furthermore, even without control, the location of the CTX images was better (compared to MOLA) than the controlled THEMIS IR mosaic.

The bulk of the mapping was done at 1:50,000. The location of certain contacts is generally accurate to a few pixels (tens of meters). Approximate contacts indicate that the actual contact (e.g., a flow margin) is not directly visible but the location can be inferred from a change in texture. Where CTX data were not available, mapping was often done at 1:100,000 and most contacts are mapped as inferred/queried. Some inferred contacts underneath thin lava and other mantling deposits are noted using the symbol for a buried contact. Contacts within a flow field are labeled as "other" and show as white lines in Fig. 1.

Athabasca Valles Flood Lava: The central goal of this mapping project is to study the flood lava that Jaeger et al. [2] showed coating Athabasca Valles. Jaeger et al. [5] show that the flow was a turbulent flood of lava with eruption rates peaking around 10^7 m^3/s. This flood lava is a proper lithochronologic unit that we have called the Athabasca Valles Lava (Aav).

The Aav exhibits a series of lava facies, from drained channels near-vent to platy-ridged surfaces in the medial portion to inflated pahoehoe at the distal margins. The most difficult contacts to identify are where the marginal inflated pahoehoe from different eruptions intermingle. The most surprising aspect of the Aav is that some parts of it appear to be being exhumed from underneath ~100 m of the Medusae Fossae Formation (MFF).

Other Geologic Features: Few events have taken place since the emplacement of the Aav. There are patches of recent aeolian dunes and, as noted earlier, some mantling by the MFF and dust. Some of the tectonic features in the study area record young deformation, probably via reactivation of older faults. For example, a wrinkle ridge near the western edge of the mapped extent of Aav is coated by lava but also appears to have deformed it.

We have also been able to decipher a large part of the sequence of lava flows erupted from small shields and fissures prior to the Aav. These are found predominantly in the southeastern section of the map area. The widely distributed vents are divides into tholi, fissures, and point vents labeled with letters in Fig. 1. Most appear to have fissure segments generally parallel to the Cerberus Fossae. We are starting to see hints that some of the vents may have fed multiple eruptions, or at least long-lived multi-phase eruptions. These details can only be observed because of the extremely pristine nature of the flow surfaces.

Remaining Work: The mapping is largely complete, though some more detail in the Elysium rise lavas is desired. The supporting text and figures are not yet ready for submission but we still expect to submit the map by the end of FY09.

References: [1] Murray J. B. et al. (2005) *Nature, 434*, 352-356. [2] Jaeger W. L. et al. (2007) *Science, 317*, 1709-1711. [3] Tanaka and Scott (1986) *LPS XVII*, 865. [4] Burr D. M. et al. (2002) *Icarus, 159*, 53-73. [5] Jaeger W. L. et al. (in revision) *Icarus*. [6] Plescia J. B. (1990) *Icarus, 88*, 465-490. [7] Lanagan P. D. (2004) *Ph.D Thesis*, Univ. Arizona. [8] Keszthelyi, L. et al. (2004) *G^3*, 5, 2004GC000758.

Figure 1. Export of ArcGIS project with THEMIS IR basemap overlain with colorized MOLA elevations and geologic linework (contacts and vent structures). Vents for the smaller pre-Athabasca Valles Flood Lava flows are labeled. Tholi are labeled ta, tb, and tc. Fissures are marked with fa, fb, and fc while small vents are va, vb, and vc. Note that there are 4 separate locations that are all labeled va because they appear to have been simultaneously active (feeding flows on both sides of a wrinkle ridge). Fissure b is mapped having fed two separate flow fields, though it is possible that these are the products of different episodes of the same eruption.